

Variability of Irreversible Poleward Transport in the Lower Stratosphere

Mark Olsen¹, Anne Douglass², Paul Newman², Eric Nash³, Jacquelyn Witte³, Jerry Ziemke¹

¹University of Maryland, Baltimore Co.

²NASA Goddard Space Flight Center

³Science Systems and Applications, Inc.

The ascent and descent of the Brewer-Dobson circulation plays a large role in determining the distributions of many constituents in the extratropical lower stratosphere. However, relatively fast, quasi-horizontal transport out of the tropics and polar regions also significantly contribute to determining these distributions. The tropical tape recorder signal assures that there must be outflow from the tropics into the extratropical lower stratosphere. The phase of the quasi-biennial oscillation (QBO) and state of the polar vortex are known to modulate the transport from the tropical and polar regions, respectively. In this study we examine multiple years of ozone distributions in the extratropical lower stratosphere observed by the Aura Microwave Limb Sounder (MLS) and the Aura High Resolution Dynamic Limb Sounder (HIRDLS). The distributions are compared with analyses of irreversible, meridional isentropic transport. We show that there is considerable year-to-year seasonal variability in the amount of irreversible transport from the tropics, which is related to both the phase of the QBO and the state of the polar vortex. The reversibility of the transport is consistent with the number of observed breaking waves. The variability of the atmospheric index of refraction in the lower stratosphere is shown to be significantly correlated with the wave breaking and amount of irreversible transport. Finally, we will show that the seasonal extratropical stratosphere to troposphere transport of ozone can be substantially modulated by the amount of irreversible meridional transport in the lower stratosphere and we investigate how observable these differences are in data of tropospheric ozone.